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DELIVERY SYSTEM FOR COSMETICS

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[Attached amendments have been incorporated into the text of translation.]

### Abstract

#### Constitution

An electrostatic spraying method for delivering cosmetics or compositions containing cosmetics onto the body, composed of an apparatus therefor, and compositions which can be used in the method.

#### Effect

Problems involving environmental pollution are addressed, and although a lesser amount of cosmetic is used than in the conventional method, equally pleasing appearance can be obtained.

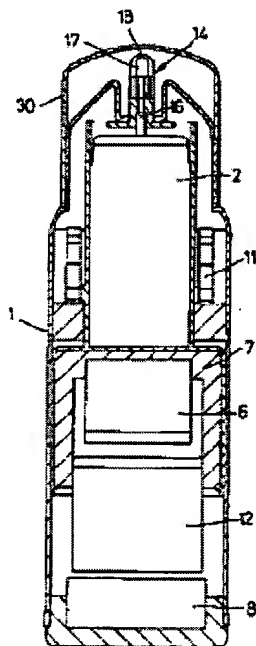


Fig. 1

### Claims

1. Method for delivering cosmetics onto the human body comprising electrostatic spraying of cosmetics onto the human body.

2. Method described in Claim 1 characterized in that (a) an apparatus is provided comprising (i) a reservoir containing a cosmetic in electrostatically sprayable form, (ii) at least one delivery means connected to the reservoir, (iii) a high-voltage generator to which power is supplied from a power source, and (iv) a control means for selective application of high voltage from the generator to one or more delivery means, and (b) the control means may be operated to electrostatically spray cosmetics onto the desired parts of the body from the one or more delivery means.

3. Method described in Claim 1 or 2, characterized by the cosmetic to be discharged (sprayed) being in the form of a composition containing at least one solvent or diluent.

4. Method described in Claim 3, characterized by the composition having a resistivity of  $10^4$ - $10^{12}$  ohm·cm.

5. Method described in any one of Claims 1-4, characterized by the cosmetic being selected from the group consisting of deodorants, antibacterial agents, fresheners, moisturizer, conditioners, and mixtures thereof.

6. Method described in any one of Claims 1-5, characterized by the high voltage generated by the high-voltage generator being in the range of 5-20 kV.

7. Method described in Claim 1-6, characterized by the voltage being 12-18 kV.

8. Method described in any one of Claims 1-7, characterized by the cosmetic being in the form of a composition which can be sprayed at a flow rate of 0.001-10 mL/min.

9. Method described in Claim 8, characterized by the flow rate being 1-3 mL/min.

10. Apparatus for spraying cosmetics onto the body, the apparatus comprising (a) a reservoir containing cosmetics in electrostatically sprayable form, (b) at least one delivery means connected to the reservoir, (c) a high-voltage generator to which power can be supplied from a power source, and (d) a control means for selective application of high voltage from the generator to one or more delivery means for electrostatic spraying of the cosmetics from one or more delivery means.

11. Apparatus described in Claim 10 characterized by further containing a substance supplying means between the reservoir and the one or more delivery means for conveying the cosmetics to be sprayed from the reservoir to the one or more delivery means.

12. Apparatus described in Claim 11, characterized by the substance supplying means containing a conduit for combining with the pump as desired.

13. Apparatus described in any one of Claims 10-12, characterized by the one or more delivery means containing a nozzle having an orifice from which the cosmetics can be electrostatically sprayed.

14. Apparatus described in Claim 13, characterized by the diameter of the orifice being approximately 400  $\mu$ m or less.

15. Apparatus for spraying cosmetics onto the body characterized by comprising (a) a housing, (b) a reservoir inside the housing which contains electrostatically sprayable cosmetics, (c) at least one nozzle having a spraying orifice connected to the reservoir to the fluid through a conduit which can be combined optionally with the pump, (d) a high-voltage generator in the housing supplied with power from the power source in the same housing, and (e) a control means for selectively applying high voltage from the generator to one or more nozzles or for electrostatic spraying of cosmetics from one or more orifices of the nozzle.

16. Combination of the apparatus described in any one of Claims 10-15 and an electrostatically sprayable composition comprising or containing cosmetics to be sprayed on the body.

17. Electrostatically sprayable composition comprising or containing cosmetics to be sprayed on the body.

18. Composition described in Claim 17, characterized by the cosmetics being selected from the group consisting of deodorants, antibacterial agents, fresheners, moisturizers, conditioners, and mixtures thereof.

19. Composition described in Claim 17 or 18, characterized by containing at least one solvent or diluent for cosmetics and at least one conventional additive as an optional component which can be found in prescriptions for products for the body.

20. Compositions described in any one of Claims 17-19 characterized by having a resistivity of  $-10^{12}$  ohm·cm.

21. Composition described in any one of Claims 17-20 characterized by further containing agents for adjusting the resistivity and/or viscosity.

22. Composition described in any one of Claims 17-21 characterized by being essentially nonaqueous or contain less than 10% water.

23. Application of cosmetics onto the human body by electrostatic spraying.

24. The application of Claim 23 characterized by the use of an apparatus described in any one of Claims 10-14.

#### Detailed explanation of the invention

[0001]

#### Industrial application field

This invention pertains to a system for spraying cosmetics on various parts of the body. Specifically this invention pertains to a method and an apparatus for spraying cosmetics on, for example, the skin and other target areas of the body using the principle of electrostatic spraying.

[0002]

Prior art and problems to be solved by the invention

Conventionally, spraying is often used for cosmetics which can be applied to various areas of the body, especially in the case of applying cosmetics to a wide or nonspecific area of the body such as the skin. This is frequently referred to as an "aerosol," generally in a can or manual pump apparatus containing a pressurized substance to be sprayed, i.e. a solution of cosmetics prepared by dissolving at least one additive conventionally used in prescribed products for the body in at least one sprayable solvent.

[0003]

These well-known aerosol spray apparatuses are not efficient and waste cosmetic raw materials. They are often bulky, heavy and expensive, and noisy when used. Moreover, problems related to these well-known aerosol spraying apparatuses generally involve the limited sensory appeal, especially the typical cold, wet mist generated. Further, the substances in these sprays are often only partially captured by deposition on the intended area of the body, therefore due to the loss of active ingredients and additives in the cosmetics to the atmosphere, considerable consumption can be observed; further, it brings about undesirable deposition of the cosmetics on the eyes and other areas of the body and air pollution, thereby there is the possibility of respiratory problems and other health problems.

[0004]

The propellants for generating aerosol sprays are often volatile organic compounds which are harmful to the environment and probably to health. In fact they are legally banned in many countries.

[0005]

Moreover, when the specific target is the entire surface area of the hair or skin (which is uneven and is very coarse under a microscope). Conventional sprays cannot be applied to 100% of the body surface due to some areas being difficult to reach.

[0006]

The principle of electrostatic spraying of liquids and solids is also well known in a very different technical field. In this technique the electric potential of the formulation to be sprayed is raised to a high electric potential in the spraying nozzle, thereby the formulation is finely divided into a mist of charged droplets. These charged droplets search for the closest grounded object for discharge, which is the desired spraying target.

[0007]

Heretofore the electrostatic spraying technique has only been proposed for spraying coating materials, adhesives, reactants such as other surface coatings, and insecticides, and for large scale application in industry and agricultural or agrochemical formulations. Examples of disclosure in this field include British Patent Nos. 1,393,333, 1,569,707, and 2,092,025; European Patent Nos. 029,301 and 253,539; and International Publication No. WO-A-85/00761. Their contents are included in this specification as reference.

[0008]

In addition, in recent years in detailed specifications excluding the patents mentioned above, a small number of proposals related to the use of the known principle of electrostatic spraying for delivering specific substances have been developed.

[0009]

In European Patent No. 224,352, the use of an electrostatic sprayer for spraying ophthalmic solutions for eyes was suggested to replace traditional eye treatment.

[0010]

Japanese Kokai Patent Application No. Sho 56[1981]-97214 (dated the year 1981) suggested the use of electrostatic spraying for coating granular (i.e., solid particle) coloring matter on the hair to coat the hair surface. The use of a hair spraying agent instead of coloring matter was obviously described speculatively, however, the disclosed system was unsuitable in terms of applicability and demand by consumers and still had the aforementioned disadvantages, especially air pollution and nonspecific application.

[0011]

That described in US Patent No. 4,776, 515 although not as related, may also be mentioned, that is an improved electrodynamic apparatus for generating negatively charged fine particles was proposed for spraying various liquids, especially aqueous solutions (including alcohol), perfume, ammonia, liquid medicine, and surfactant. The purpose of the disclosed system is to provide an ozone-free mist of negatively charged liquid particles (with the presupposition that the substances to be sprayed can be charged). The mist thus formed is immediately dispersed in an open area such as a room where the apparatus is to be used. Accordingly a uniform aerosol can be generated in a wide area, which is applicable to a large public place such as a hospital, restaurant, office, etc. Obviously this system is not suitable for

small scale use such as individual use and, for many objects, it may directly conflict with the principle which may solve the problems of the above-mentioned prior art.

[0012]

As a result of confirming and understanding the above known problems, disadvantages, and limits, and by carrying out many experiments, the inventors invented a system which can effectively use the principle of electrostatic spraying in the case of spraying cosmetics onto various parts of the body. Accordingly such an apparatus and method provide good technical efficiency, cost effectiveness, safety, and comply with the applicability of many consumers and solve many problems related to the prior art (even if not at all related) or at least to an improved delivery method.

[0013]

Means to solve the problems

Thus in the first invention, a method is provided for spraying cosmetics onto the body including electrostatic spraying of the above-mentioned cosmetics onto the body.

[0014]

More specifically, the method of this invention preferably provides

(a) an apparatus comprising (i) a reservoir containing a cosmetic in electrostatically deliverable form, (ii) at least one delivery means connected to the reservoir, (iii) a high-voltage generator to which power is supplied from a power source, and (iv) a control means for selective application of high voltage from the generator to one or more delivery means and (b) in a second invention, which comprises the operation of a control means for electrostatically spraying the cosmetics from one or more delivery means onto the intended areas of the body, this invention is an apparatus for delivering cosmetics to the body and comprises (a) a reservoir containing cosmetics in a electrostatically sprayable form, (b) at least one delivery means connected to the reservoir, (c) a high-voltage generator to which power is supplied from a power source, and (d) a control means for selective application of high voltage from the generator to one or more delivery means to electrostatically spray cosmetics from the one or more delivery means.

[0015]

A third invention provides the apparatus defined above and a composition made of or containing electrostatically sprayable cosmetics for application on the body.



[0016]

For fourth invention the cosmetic to be sprayed may be any conventional cosmetic which can be sprayed by well-known aerosol spraying methods, however, it is preferably a chemical which can be generally applied onto the body for imparting at least one desirable sensory advantage; preferably the advantages are related to the sense of smell, touch and feel.

[0017]

Very unexpectedly, it became clear that the effective spraying technique for providing the novel spray system of this invention and significant further capture generated an exceptional, unexpected sensory result when the active substances of cosmetics were sprayed onto the body, especially the back, leg, and arm. The 360-degree wrap-around high capture of the substances and the quite invisible and nonwet spray properties are especially novel and advantageous characteristics in the specification of this invention.

[0018]

While referring to the attached figures, the main inventions described, preferable embodiments, various optional characteristics and properties will be explained.

[0019]

The cosmetic to be delivered using the system of this invention may be any broad-range substance for imparting at least one sensory advantage to an area of the body such as the skin. The preferable cosmetics which contain a single substance or a combination of several substances impart deodorization, antibacterial, refreshing moisturizing, or conditioning effects and examples of such chemicals are well known to those skilled in the art. Examples of the above known active substances of cosmetics are given below:

1. Deodorant--perfume, essential oil.
2. Antibacterial agent--triclosan (2,4,4'-trichloro-2'-hydroxydiphenyl ether), chlorhexidine acetate (1,6-di-N-p-chlorophenyldiguanido-hexane acetate).
3. Fresheners--ethanol, volatile hydrocarbons, volatile silicones, menthol.
4. Moisturizer--glycerol, isoprene glycol, 2-pyrrolidone-5-carboxylic acid, 2-hydroxyalkane acids, and their acid-soap composites.
5. Conditioner--silicone oil, silicone copolyol, olive oil, and other vegetable oils.

[0020]

The particularly useful substances applicable to this invention as active chemicals are deodorants which can be found in conventional body sprays containing at least one perfume.

[0021]

The special advantage of this invention is the omission of at least several or essentially all additives commonly used in body sprays and other cosmetic sprays, thereby generating a simple and less expensive and less wasteful delivery system (however, this is not applicable generally to solvents, diluents, or carriers, which are still preferably present as will be explained later). However, these optional additives can be used within the scope of this invention if desired or necessary.

[0022]

Within the above-mentioned outline, the cosmetics to be delivered according to this invention are in the form of compositions which contain at least one solvent, diluent, or carrier and a small amount of at least one additive well known in this field which are to be described below or contain none of these additives. The suitable solvents, diluents, and carriers are soluble, solubilizable, or miscible with the active substances of the cosmetics to be sprayed. Examples of the suitable solvent or diluent include alcohols or polyols such as ethanol, isopropyl alcohol, propylene glycol, dipropylene glycol, phenylethyl alcohol, glycerol, 1,3-butanediol, 1,2-propanediol, isoprene glycol, etc.

[0023]

In the above-mentioned compositions of this invention to be delivered, the concentration of the active substances of the cosmetic may vary widely. For example, it can be selected based on the type of substances and systems to be sprayed and other spray parameters and/or the demand or desire of the user. The suitable concentration of the active ingredient is approximately 0.01 wt% to approximately 99 wt%, more preferably approximately 0.1 to approximately 80 wt% based on the compositions. Specifically, the above active substances can be used effectively at the concentrations shown below.

[0024]

Deodorant: perfume	0.01-10 wt%
Antibacterial agent	0.1-2 wt%
Freshener: menthol	0.1-2 wt%
Volatile oil	10-75 wt%, more preferably 10-25 wt%
Ethanol	1-99 wt%
Moisturizer	0.1-30 wt%
Conditioner	1-75 wt%, more preferably 5-25 wt%

[0025]

The compositions to be delivered in this invention are preferably liquids. In addition to the optional solvents or diluents to be mixed with the cosmetics, further optional additives are preferably liquid at room temperature, but any solids can be used as long as the amount used is small and it does not cause the composition to lose electrostatic sprayability.

[0026]

In this invention, one or more active cosmetics and sprayed from a single delivery means of the apparatus and the identical composition is obtained; by simultaneous delivery of different cosmetics from different delivery means, they can be delivered simultaneously.

[0027]

Generally speaking, the fact that the compositions are electrostatically sprayable is the indispensable condition for the compositions useful in this invention.

[0028]

The necessary main specific character (as will be further discussed later) of such electrostatically sprayable compositions which must be carefully selected or adjusted is their resistivity. The desirable resistivity is approximately  $10^4$ - $10^{12}$  ohm·cm, more preferably  $10^6$ - $10^{10}$  ohm·cm. The resistivity may also be less than  $10^4$  ohm·cm. It may also be greater than approximately  $10^{12}$  ohm·cm, for example, up to  $10^{14}$  ohm·cm or greater; however, it is difficult to measure such a large resistivity using a conventional, inexpensive resistance measuring apparatus. Resistivity is measured generally at 25°C using a standard apparatus and method.

[0029]

Preferably the compositions of this invention to be delivered are either essentially nonaqueous or may contain very little water such as 10 wt% or less, preferably 5 wt% or less, more preferably 1 wt% or less. This is due to its low resistivity, primarily aqueous compositions cannot be effectively sprayed using an electrostatically sprayable means.

[0030]

As mentioned above, depending on the composition or cosmetics to be delivered, it is necessary to add at least one resistivity-adjusting substance to adjust the resistivity; such substances to be added and their suitable amount are either well known to those skilled in the art or can be determined easily by simple experimentation. It is suitable to use a polar substance such as an alcohol, e.g., ethanol to reduce the resistivity of the given cosmetics or compositions

containing the cosmetics or, on the other hand, add a nonpolar substance such as an oil or other hydrophobic substance to increase the resistivity. Examples of more suitable resistivity-adjusting agents include salts such as sodium chloride and charged species such as salts traditionally used in products for the body or buffer solutions in medical prescriptions. Generally speaking, preferably the optional agents used for adjusting the resistivity are soluble, can solubilize or are miscible with the cosmetic or cosmetic-containing compositions.

[0031]

In relation to this invention, especially in relation to body sprays containing perfume solutions prepared by dissolving perfume in an alcohol, especially ethanol; the change in resistivity with the concentration of the perfume is atypical; it became clear that an unexpected resistivity profile was generated as is explained by the attached Figure 3, which shows, the resistivity profile of an ethanolic solution of perfume (HDO220, Quest International Co.) in various compositions.

[0032]

Unexpectedly, when a perfume with a higher resistivity than ethanol was added, the resistivity of the mixture decreased. This behavior is presented by a relatively wide range of compositions. It was particularly unexpectedly found that the resistivity of the mixture of perfume and ethanol was lower than that of perfume or ethanol alone. This unexpected behavior raises an important point in regard to the optimization of the given spraying system and can be used as a guide to select other spray parameters, at least to some degree, as will be further described below. For example, as with the similar data related to other combinations of substances, these data of resistivity can be used to predict the spraying characteristics or electrostatic sprayability based on the resistivity or spray properties in consideration of the given concentration of the active substance of the cosmetics and the variability related to other parameters of this system such as flow rate or voltage and/or limit.

[0033]

In addition to the resistivity, the viscosity should be carefully selected and adjusted as needed in the compositions to be sprayed.

[0034]

Compositions with a wide range of viscosities are suitable for use in this invention, however, the suitable viscosity is approximately 0.1 to approximately 50,000 mPas, more preferably approximately 0.1 to approximately 10,000 mPas, most preferably approximately 0.5

to approximately 5000 mPas (all at 25°C). If desired or if necessary one or more viscosity-adjusting agent may be included. Examples of such agents include salts, such as alkali metal or halogenated ammonium salts, polymers and conventional thickeners, oils and polar oil thickeners such as cosmetic oils, waxes, glycerides, and suitable amphipatic substances with melting points >20°C.

[0035]

The hardware, electrical constituting components, and electrical circuit mechanisms used for this invention may be any suitable and designed structure. The electrostatic spraying method of this invention contains many examples of suitable apparatuses which can be used and the disclosure which is related to such apparatuses or their specified characteristics can be applied to the spraying system of this invention either independently or as a combination with others.

[0036]

As a suitable example of the electrostatic spraying hardware, in addition to the above-mentioned prior art, there is the following literature already published: Great Britain Patent Nos. 2,061,769 and 2,073,052; European Patent Nos. 031,649; 132,062; 163,390; 171,184; 234,842; 243,031; 368,494; 441,501; 468,735; and 468,736. The content of these specifications are for reference only in this invention.

[0037]

As can be understood by those skilled in the art, the specific constructional characteristics and design and electrical and other operational parameters of such apparatuses are necessary, and in relation to this invention, they are selected or adjusted based on the desired functional characteristics such as the composition and substances to be sprayed and/or the needs and desire of the users.

[0038]

The characteristics of the apparatus of this invention to be selected and/or adjusted include, for example, the high-voltage generator and the voltage generated by a power source, the electric field strength inside the substance delivery means, the flow rate of the substance from the reservoir to the delivery means and the flow rate of the substance sprayed from the delivery means, the size and arrangement of the delivery means, and the construction and characteristics of the optional substance supply mechanism arranged between the reservoir and the outlet of the conveying means.

[0039]

In a preferred embodiment of this invention, the preferred voltage generated by the high-voltage generator from the power source is approximately 5 kV to approximately 20 kV, more preferably approximately 12 kV to approximately 18 kV. A voltage higher than 20 kV such as up to approximately 24 kV or greater may be used if desired, e.g., for substances to be sprayed with especially low resistivities such as approximately less than  $10^6$  ohm·cm and/or especially high flow rates such as greater than 5 mL/min. The optimum voltage for the given system depends on the substance to be sprayed and other parameters, all of which are selected to obtain an overall optimized system. However, as a general rule, in the case of using the preferable embodiment of the apparatus of this invention (to be further explained below), as to the given flow rate of the substance during delivery in the case of using a liquid substance having a relatively low resistivity such as approximately less than  $10^6$  ohm·cm, it became clear that a high voltage was necessary to maintain a fine spray with a large spraying range. This is illustrated in the attached Figure 4(a-e).

[0040]

The electric field strength, which is related to the spraying action of the electrostatic apparatus, is largely dependent on the voltage applied. However, when necessary, the electric field strength can be controlled or adjusted by arranging or changing the shape of the nozzle and/or by the use of an electric-field increasing electrode, as sufficiently well known in the above prior art.

[0041]

The optimum flow rate of the substance to be sprayed often depends on the concentration of the substance of the composition, e.g., the "active" component of the cosmetic to be delivered. Further, as already mentioned with respect to the viscosity of the sprayable substance, the suitable flow rate may be selected based on the specified delivery regimen and/or the habit or demand of the user. For example, the preferable flow rate of the composition to be delivered according to the embodiment of this invention is approximately 0.001 to approximately 10 mL/min, more preferably approximately 0.1 to 5 mL/min, most preferably approximately 1 to approximately 3 mL/min according to the delivery means. In the case of using the preferable embodiment of this invention (to be explained further below), the latter flow rate, i.e., 1-3 mL/min is most preferable for obtaining a fine mist with a large spraying range, and it became clear that this is more preferred in terms of feel than equal spraying, which is generally coarse and narrow. This is illustrated in the attached Figure 5(a-e).

[0042]

The size and arrangement of the one or more delivery means in the apparatus of this invention are of an optional suitable form, and further, to obtain the optimally functionized electrostatic spraying system, they can be selected in relation to other parameters. Generally speaking, the one or more delivery means are in the form of nozzles made of an insulating or semi-insulating substance such as plastic or various polymers, as is well known to those skilled in the art.

[0043]

In the desirable nozzle form, the conduit for conveying the substance to be sprayed ends inside the orifice of the tip of the nozzle, and the substance from the orifice is ejected, for example, in a stream at the beginning, but dispersed in the end as a mist of charged droplets. Preferably the diameter of the orifice is approximately 400  $\mu\text{m}$  or less, more preferably 350  $\mu\text{m}$  or less. Further preferably, the diameter of the orifice is approximately 125-250  $\mu\text{m}$ .

[0044]

It is advantageous if, in the delivery means, there is a measuring means for providing a feeding mechanism for delivering the predetermined fixed amount of substance from one or more nozzle. Preferably, a convenient measuring means is combined with a system having a controlled flow rate.

[0045]

In a desirable embodiment of the apparatus of this invention, the one or more delivery means or each delivery means is connected through the substance supplying means to one or more reservoirs (e.g., in case it is desired to spray more than one cosmetic or composition from the same apparatus or the same delivery means), namely, preferably fluid communication is carried out. It is preferable that such a supplying means contain, for example, a hollow conduit in which the substance or composition can pass through under the influence of capillary action. Especially in a system which needs a high flow rate, another supplying means such as a pump may also be added. This may be an optional suitable type which can be operated electrically, however, a simple mechanical apparatus which can apply pressure on one or more reservoirs containing one or more substances or compositions is more convenient, and by using it the content can be ejected and conveyed to the delivery means. Or the supplying means may contain a wick, e.g., a porous wick, and the substance is sprayed in a flow in the wick and/or on it, and reach the point of high electric field strength as dispersed droplets or a spray of charged particles.

[0046]

As well known in this field, the apparatus of this invention contains preferably a trigger (i.e., a manual control means) or an automatic control means for selectively applying high voltage from the generator on the one or more delivery means to electrostatically spray the cosmetics or compositions on the intended are as of the body. However, other optional, suitable control means which can automatically control the operation of the system may also be used, this means being preferable in this field.

[0047]

The present inventors will now describe two preferable embodiments of the apparatus of this invention in detail with reference to the appended Figures 1 and 2.

[0048]

In a first typical, preferable embodiment shown in Figure 1, in order to form a hand-held unit suitable for individual use which is easy to hold and use, the spray is constructed with the same size, shape, and weight as that of a conventional aerosol spray. This apparatus contains a long and narrow housing 1; it is preferably an insulating material, namely made of plastic in which electronic parts of the apparatus and other hardware are installed.

[0049]

In the bottom of the apparatus there is a cell 8 which can accommodate batteries conventionally used with a low voltage such as 1.5-12 V, especially 9 V, and at this position batteries can be easily replaced when necessary. The section denoted by the numeral 6 is the high-voltage generator which converts the low voltage of the batteries 8 to as high a voltage as approximately 12-18 kV, which is necessary to electrostatically spray the substance to be sprayed. The suitable material for the high-voltage generator 6 is well known in this field and includes mainly coils or transformers for carrying out the voltage step-up function. If desired or necessary, various fillers which are electric insulators shown as 7 in Figure 1 are to increase the safety of the high-voltage apparatus and reduce the leakage of electricity during use of the apparatus.

[0050]

One or more circuit boards 12 containing optional or necessary auxiliary electronic parts for guaranteeing effective and satisfactory functioning of the apparatus are connected between the batteries 8 and the high-voltage generator 6 and between the high-voltage generator 6 and the remaining electronic parts. Such one or more additional circuit boards include, for example, a



DC/AC (or vice versa) converter and a voltage adjusting means which controls the high voltage applied on the substance delivery means from which the substance to be sprayed is delivered.

[0051]

The reservoir 2 is in the upper part of the apparatus, and in the preferable embodiment it is a bag-in-can-type reservoir which is well known in the field of products for the body and spraying apparatuses. The bag-in-can-type reservoir 2 constitutes a low-voltage substance supplying mechanism, by which the substance to be sprayed is supplied to the nozzle 14 of the apparatus which is ready to be used for medium to high flow rate spraying. The substance to be sprayed in the reservoir 2 can be optionally a wide-range substance as already mentioned; however, when it is to be applied to the body, it is preferably one or more compositions made of cosmetics or containing cosmetics which can provide one or more sensory advantages related to the sense of smell, touch and/or feel. In one preferable embodiment, the substance to be sprayed is the same as a body spray, i.e., a solution of perfume prepared by dissolving perfume in ethanol.

[0052]

At the time of fluid communication with the reservoir 2 through the conduit 16, the nozzle 14 is connected electrically to the high-voltage electric circuit of the apparatus, thus the voltage for spraying the substance from the nozzle under electrostatic force is raised to the high voltage necessary to carry out the electrostatic spraying. The nozzle 14 contains the inner chamber 17 which ends at the tip of the nozzle at the orifice 18 where the substance inside the chamber 17 is sprayed under the influence of electrostatic force. As already mentioned, the most suitable orifice 18 has a diameter of approximately 125-250  $\mu\text{m}$ , and the most preferable flow rate of the substance exiting is approximately 1-3 mL/min. To obtain such a flow rate, generally it is necessary to use a substance supplying means such as a pump (not shown in the figure) to convey substance from the reservoir 2 to the nozzle 14. Generally speaking, a positive pressure of approximately 1-4 psi is suitable for this purpose.

[0053]

To obtain a system optimized with respect to the substance to be sprayed, the arrangement of the nozzle 14 in the domain of the orifice 18 is selected according to other spraying parameters. For example, the arrangement of the tip of the nozzle shown in Figure 1 is especially suitable for a liquid with a relatively high resistivity such as greater than approximately  $10^7$  ohm-cm, and such an arrangement generates a very satisfactory fine and wide mist.

[0054]

Preferably this apparatus is equipped with the cap 30 for protecting the nozzle 14 at the upper part of the apparatus and its other delicate parts from contamination and damage when the apparatus is not used.

[0055]

The numeral 11 in Figure 1 is a manual trigger which constitutes the control means for selectively increasing the voltage of the unit for applying high voltage to the nozzle for electrostatic spraying of the substance. Like other elements of the apparatus, the trigger 11 can be subjected to undesirable electrical leakage or impact. Thus to minimize the undesirable electrical leakage or impact, it is desirable that the trigger is constituted and arranged according to the scheme well known in this field.

[0056]

Figure 2 shows an expanded embodiment of this invention. The basic plan and construction of the apparatus are almost the same as those mentioned above; however, in this case the size and arrangement of some parts are changed.

[0057]

As shown in the figure, the reservoir 2' containing the substance to be sprayed is constructed as a positive-pressure substance supplying apparatus incorporated with a diaphragm pump. Such a pump is well known in the field. Thus the reservoir 2' delivers the fixed-amount substance to be delivered at a medium-high flow rate to the spray nozzle 14'. As shown in the figure, during any step of operation of the apparatus, in order to guarantee the spray of a fixed amount of substance, the measuring means 17 is provided between the reservoir 2' and the nozzle 14'.

[0058]

In the embodiment of another apparatus shown in Figure 2, the electronic hardware is preferably accommodated in the lower part 20 of the apparatus, which constitutes a separable module modeled for easy exchange with, for example, the different upper part of an apparatus having a reservoir containing different deliverable substances.

[0059]

In the illustrated changed arrangement of the nozzle 14', the substance has the tendency to return the trigger operated manually by the user, thus by using the trigger control means 11'

which is located at the tip of the apparatus, the leakage of electricity can be reduced, and by a method similar to that of a common aerosol spray, it can be sprayed horizontally from there. This behavior is especially undesirable; therefore, generally in the case of grasping the apparatus by hand during use, it is important to increase the distance between the fingers of the user and the orifice 18, 18' of the nozzle 14, 14'.

[0060]

Further, Figure 2 shows another arrangement of the nozzle 14' in the orifice 18'. However, it became clear that a specific arrangement was useful for carrying out fine and broad spraying of substances having a relatively low resistivity such as less than  $10^7$  ohm-cm.

[0061]

In order to prove the advantage of the cosmetic spraying system of this invention when compared with the conventional aerosol spray method, several comparative experiments were carried out such as the following application examples.

[0062]

Application examples

Application Example 1

A conventional "IMPULSE" aerosol perfume body spray was compared with the spray of an equivalent composition using the preferable apparatus of this invention. The main characteristics of the apparatus used are illustrated in Figure 1 which corresponds to that already described, but it further contains a means for changing the operational parameters such as flow rate and voltage. The spraying voltage used was 16 kV and the flow rate of the substance was 1.5 gms/min. The substance sprayed was a 1 wt% solution prepared by dissolving the same perfume as in IMPULSE body spray in ethanol.

[0063]

Two types of delivery methods were used by 15 panelists (two panelists per group) to carry out a comparison. As shown in the following table the panelists scored each regime in each of the 7 specific characteristic. The skin was sprayed and the spraying was continued for two seconds.

[0064]

The results are shown in Table 1.

[0065]

Table 1

	特性に関する平均得点	
	静電吹付 (本発明)	IMPULSE吹付 (従来技術)
適用中の騒音	2	7.6
適用中の力	7	7.9
適用中の曇り (mistiness)	1.7	7.5
適用中の寒気	4.5	8.8
適用中の冷気	6.2	8.4
適用中の清新感	6.0	7.1
適用後の香料強度	4.5	6.3

Key: 1 Average score obtained in specific characteristic  
 2 Electrostatic spraying (this invention)  
 3 IMPULSE spraying (prior art technique)  
 4 Noise during application  
 Force during application  
 Mistiness during application  
 Coldness during application  
 Chilliness during application  
 Refreshing feel during application  
 Intensity of perfume after application

[0066]

Thus it was perceived that the electrostatic spraying system of this invention is significantly quiet, not powerful, and less misty than those of the conventional spraying system. The coldness and chilliness during application were reduced, and on the other hand, the refreshing quality and the intensity of the perfume after application were maintained. However, when compared with the prior art, it exhibits the positive advantages of this invention. A further advantage includes the electrostatic spraying system spraying approximately 1/20 the amount in the case of a conventional aerosol; thus the system of this invention exhibits more effective utilization of the perfume.

[0067]

#### Application Example 2

The experiment of Application Example 1 was repeated. However, this time the electrostatic spraying apparatus of this invention was used under the conditions of a flow rate of 3.0 gms/min and voltage of 18 kV. The comparative tests by 2 people per group for the same specific characteristic were carried out by 18 panelists. The results are shown in the following Table 2.

[0068]

Table 2

	特性に関する平均得点	
	静電吹付 (本発明)	IMPULSE吹付 (従来技術)
適用中の騒音	4	7.9
適用中の力	1.9	8.0
適用中の曇り (mistiness)	2.3	6.3
適用中の寒気	5.9	7.9
適用中の冷気	7.0	8.1
適用中の清新感	7.1	8.0
適用後の香料強度	6.0	7.6

- Key: 1 Average score obtained in specific characteristic  
 2 Electrostatic spraying (this invention)  
 3 IMPULSE spraying (prior art)  
 4 Noise during application  
 Force during application  
 Mistiness during application  
 Coldness during application  
 Chilliness during application  
 Refreshing feel during application  
 Intensity of perfume after application

[0069]

The above results show that similar excellent sensory advantages can be felt at a relatively high flow rate (coarse droplet size) and when the amount used in the electrostatic spraying method was 1/10 that of the conventional aerosol, the sensory perception of the perfume was relatively close to that of the prior art.

#### Brief description of the figures

Figure 1 shows a basic diagram for one preferable embodiment of the apparatus of this invention.

Figure 2 shows a basic diagram for another embodiment of the apparatus.

Figure 3 shows the change in resistivity when a composition of a perfume solution prepared by dissolving the perfume in ethanol was used.

Figure 4(a-e) shows the spray width characteristics of various ethanol solutions of perfume using the preferable apparatus of this invention.

Figure 5(a-e) shows the spray quality of various ethanol solutions of perfume using the preferable apparatus of this invention.

## Explanation of symbols

1	Housing
2, 2'	Reservoir
6	High-voltage generator
7	Insulating substance
8	Battery
11, 11'	Manual trigger
12	Circuit board
14, 14'	Nozzle
16, 16'	Conduit
17	Internal chamber
18, 18'	Orifice
20	Lower part of the apparatus
30	Cap

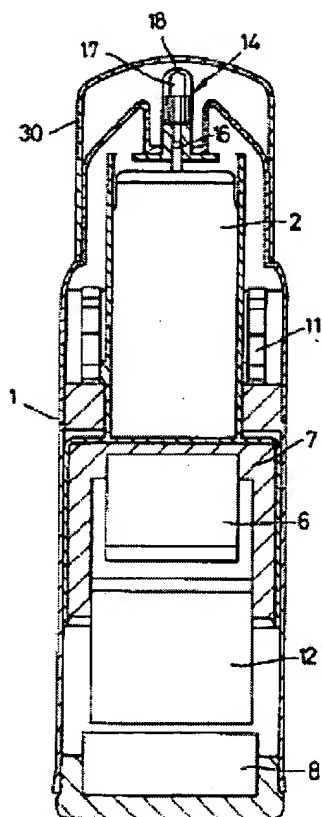


Fig. 1

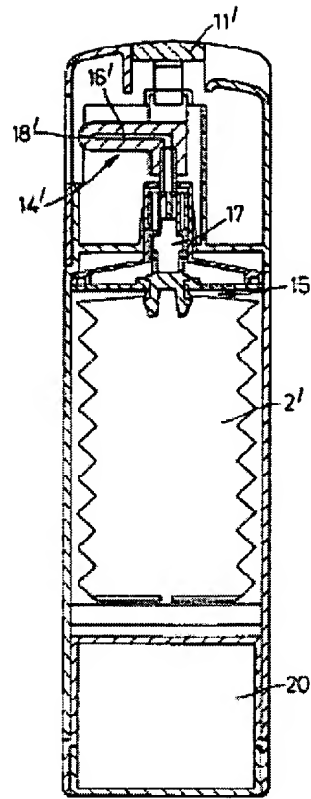


Fig. 2

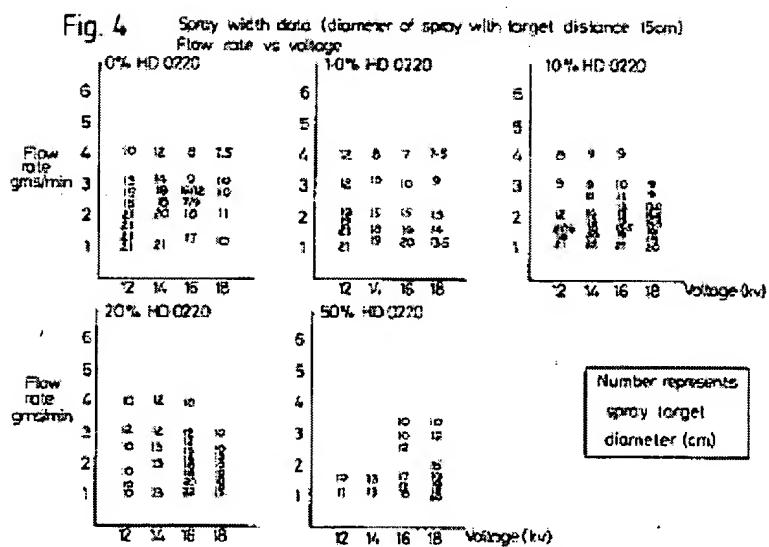
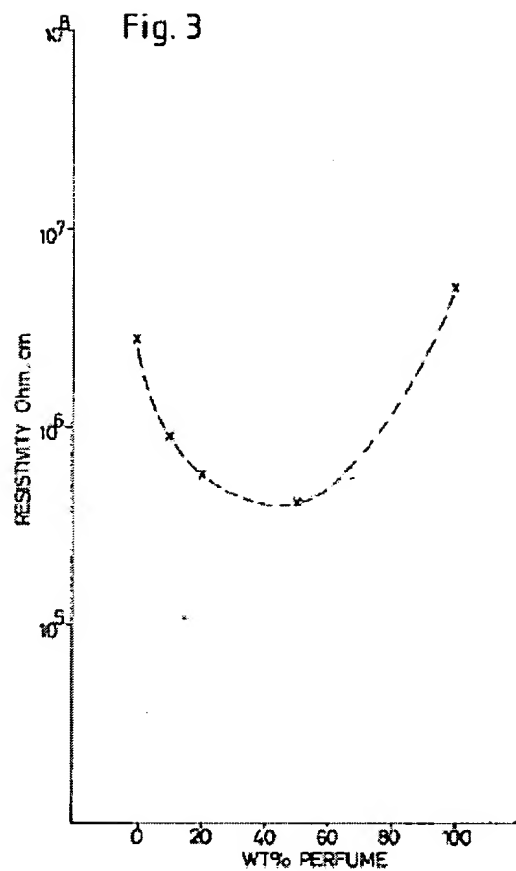




Fig. 5 Spray quality characterisation data - visual assessment of appearance  
(Flow rate vs voltage)

